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Improving an urban distribution centre, the French case of Samada Monoprix

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Abstract

Monoprix has implemented since several years a new scheme of transport, supplying goods in the city centre thanks to rail and NGV vehicles. This innovative organisation reduces by 49% the environmental impacts but still generates extra costs.
The objective of this paper is to propose optimisation possibilities and their evaluation regards to economic and environmental impacts. We analyse scenarios Monoprix can implement and give some recommendations. This work takes part from the Chair of City Logistics of MINES ParisTech called "FRELON".

Keywords: Urban distribution centre ; city logistics ; rail approach ; NGV goods vehicles

1. Introduction

As mentioned by Zunder and Ibanez [1] urban freight platforms have proven a conceptual failure. The case we discuss in this paper does not avoid this rule because the economic balance is still not achieved. This is why the work done in this paper was strategic because it consists in determining an urban distribution centre business model able to be efficient. Taniguchi, Thompson and Chwesiuk (in [2] and [3]) underline urban freight platform as a possible way to optimize city logistics, but each experiment failed. Definitions of Urban Consolidation Centre are largely known in the literature; probably the most famous is mentioned in [4]. Projects of UCC are numerous and very often they tend to be a success before

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their implementation as it was mentioned for La Rochelle or in the Westpomeranian Region of Poland [6]. In this paper we propose new scenarios and evaluate them in order to identify the value of each parameter we took into account allowing an economic balance of the parisian platform of Samada Monoprix.

The assessment of an urban freight platform is still a very recent issue and only a few works exist on the subject [7].

Monoprix is a major French supermarket chain, specialized in convenience stores, and strongly established in city centres, especially in Paris and its suburb. Involved in a sustainable development policy for 20 years, the group pays much attention to the environmental impacts of its activities, especially its logistics.

That is why SAMADA (logistical subsidiary of Monoprix) worked in partnership with public institutions (regional direction of equipments, Ile de France region, city of Paris, RFF (French railway network) and research institutions such as MINES ParisTech) to design and implement a new scheme of transport to supply the Monoprix stores located in Paris and its close suburb.

This new organisation consists in gathering freight flows toward Parisian stores via the railway using a logistical platform situated in Paris (called “Halle de Bercy”). Because of huge volumes, electric vehicles are not suitable for this activity, for this reason, the case illustrated in [8] is not feasible for Monoprix, consequently Monoprix choose NGV (natural gas for vehicles) vehicles cleaner than diesel ones. The products involved in this operation are “general goods” (textile, hygiene, non-foodstuffs…) and the “soft drinks” (water, milk, juice, sodas…), which are prepared in 2 warehouses situated in Combs and Lieusaint, 40 km away from Paris, and linked to the railway serving the south east suburb of Paris.

Currently, the platform receives one train per day, from Sunday evening to Thursday evening, with 17 cars carrying about 750 pallets on average, which are unloaded, scanned and stocked during the night, from 9.30 pm to 4.30 am, after that, they are loaded from 6 am (from Monday to Friday), in the NGV trucks, which come to Bercy after having delivered fresh foods from others refrigerated platforms. The 26 trucks are then reused as many times as necessary to deliver the 94 stores in Paris and the suburb.

In 2009, this new scheme of transport brought a reduction of greenhouse gas (CO2…) and pollutants (NOX, COV…) emissions by 49% in comparison with the previous situation, in particular by reducing the total distance covered by trucks in the Ile de France region [9]. This new design of the supply chain is currently a source of additional costs due to the innovative parts of the scheme of transport (rail transport, breakdown, NGV motorization). This is the main reason why SAMADA looks for new solutions to reduce the additional costs. They have been evaluated in 2009 by Interface Transport and Delaître [9] and were equal to 26%. In 2010, the overcost decreased to 18% thanks to local improvements of the process.

Within this context, this research paper deals with the identification and the assessment of the possible actions of optimization, economically and eco-friendly speaking. To identify how to optimize the platform, we first concentrated on the available space function to the time. Many ideas had been mentioned internally but not quantified; thus the study proposed different operation scenarios dealing with the management of Samada, based on reliable data, permitting them to choose which direction to take. This paper begins by describing the current organisation, then details the different data of the evaluation model as well as the assumptions and compares the different scenarios respect to their economic and environmental interests.

2. Detailed description of the current logistical plan

2.1. Generalities

Bercy is a bimodal cross-docking platform run by Samada in the 12th of Paris. Its surface of 3700m² is left to Samada by the SNCF, the owner of the plot.

Bercy is a leading platform of the neighbouring warehouses of Combs-la-Ville and of Lieusaint. Combs-la-Ville centralises general goods whereas Lieusaint, which is adjacent to it, handles soft drinks. These two warehouses, within the framework of the Bercy project, have been linked by railway to the French national railway network. Every evening, a train leaves both warehouses to Bercy, where it arrives around 9.30pm. There, the pallets are unloaded and placed in their respective rows, according to their shop.

In the morning, (between 6am and 12pm), the pallets are loaded in the trucks and delivered to the shops. At the exception of 3 shops (Nation, Poissy, and Saint-Germain), of which the constraints require a final delivery by a diesel fuelled vehicle, this “last mile” is carried out by a dedicated fleet of 26 NGV lorries. These vehicles, after having carried out a first delivery of fresh produce from the departure from their respective fresh products platforms, return to reposition themselves at Bercy where they carry out one or two MG-BSA delivery rounds before returning to their original platforms. Therefore, apart from the nocturnal loading/unloading activity and dispatching in the morning, Bercy is empty in the afternoon. It functions five days a week (from Sunday evening to Friday).

2.2. The existing costs of the platform

Before the establishment of Bercy, a part of the MG-BSA flow departing from Combs/Lieusaint passed through a platform situated at Thiais, which streamlined the distribution by acquiring articulated trucks rounds on entry and by carrying out final distributions of 15 or 21 pallets in Diesel carriers.

Anxious to evaluate the additional cost engendered by the new approach via Bercy, Samada, ordered an official study in 2009 looking to establish the environmental cost and gains of the news system. This study compares the current situation with an ex ante situation estimated (i.e. taking into account news delivery points) via Thiais.

The study concludes at additional costs of 26% per pallet (necessary investments rail link included) and a decrease of 49% of the emissions. This assessment leads to the motivation to decrease the overcosts by optimising the resources of Bercy.

2.3. Existing axes of improvement

In order to better pay off the fixed expenses linked to the platform, Samada concern had put in place, in 2009 and 2010, many solutions to improve productivity.

The mutualisation of the flow, already at the heart of the system with the usage of the same carriers for fresh products, soft drinks and general goods, is actively researched by Samada. We can recall the experiences of the Masséna Casino, facilitated by the proximity with Easydis, the logistical subsidiary of Casino. In 2009, a project of the delivery of non fresh products of the Parisian stores of casino with docked passage to Bercy was studied, with a railway approach since the Easydis warehouse branched with Besancon. Financial restraints linked to the railway approach contributed to the abandoning of the project.

The liberation, in the afternoon, of a logistical space rented at a strong price downtown in Paris fed the hopes of a mutualisation with an outside player in order to occupy Bercy in the afternoon: e-commerce

activities or express pick-ups were mentioned and articles were published to this end in the specialist press. However, for instances, no project has been launched.

3. Methodology

The methodology of the study was as follows: Initially, the current state of Bercy has been analysed and quantified. An economic and environmental evaluation tool for these scenarios has been built and given results. The interaction with the different people affected in the supply chain (the managers at Bercy, operators, employees at Combs-la-Ville and Lieusaint, shops....) permitted to fix the operational feasibility of each option.

Our work is organized as follows:

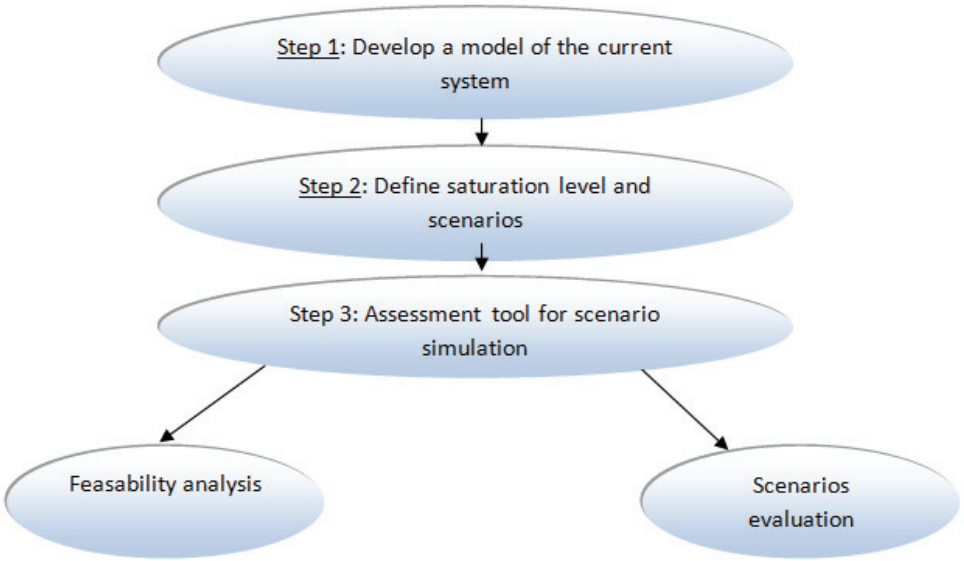

Fig. 1. Methodology

The first step aims to develop a simulation tool able to represent what happens in the platform and to validate the proposed model with true and available data.

Step 2 aims to define the scenarios Monoprix could implement in order to improve the platform productivity. The scenarios are translated into value of system variables (available space, number of cars per train, etc...).

Step 3 uses the model given in step 1 in updating the variables involved in the scenarios defined in step 2.

Finally, step 4 consists in two sub steps: one is in charge of studying the feasibility of the scenarios selected in step 2 by checking the physical limits and the second evaluates the scenarios from an economic and environment point of view in order to evaluate the savings (or not) in terms of euro and pollutants emissions.

4. Step 1: Developing the model

Before approaching the development of new scenarios of Bercy, a tool to model the morning activity (from 6am to 1pm) needed to be built: the loading and departure of the lorries. The morning activity of Monoprix constituting the main optimisation gear of the study, the limiting factor of the current system and that which is the closest to the final client (the Monoprix shops), it was essential to well comprehend it. The objectives of the modelling of Bercy were as follows:

- An internal objective, permitting us to visualise the monitoring of activity at Bercy, notably at the level of the returns of the lorries;
- A better understanding of the process at Bercy;
- The measure of the threshold of saturation, if this had been roughly evaluated, it had never have been determined for sure ;
- For each scenario foreseen, the determination of available spaces for an exterior service, and at what time.
- For each of these scenarios, the identification of the end of the expedition activities, and therefore the availability of Bercy.

The model realised on Excel constitutes a simulation of the activity of Bercy, but based on reality: it retranscribes the data extracted from the archives for a given day, but carries out some assumptions for the non-retranscribable data at a large scale (number of on-board pallets in each lorry, duration of the sorting of the empty pallets, the space taken up by a pallet....) It is thus an approximate model, but gives us a good idea of the activity which corresponds to a given scenario.

4.1. The function of the model

The realised model takes the data of a realised day; thus it retranslates activities achievable in the future. These can be modified in order to simulate a future scenario.

The following is its input:

- The volume data for the day in consideration;
- A transport plan precising the departure hours for the lorries and their allocated shops, in the standardized form of Excel under which it is retranscribed each day by the concern.
- Preferably, a statement of the arrival trains of the lorries at Bercy.

The macro produced, on leaving, and according to the time:

- The quantity of equivalent pallets present in Bercy;
- The available storage space;
- The occupation of the doors by the lorries.

The curves represent the available space of the platform depending of the time. “MPX” means Monoprix flows and “MPX+CAS” means Monoprix and Casino flows. Currently, some casino flows are oriented toward the Samada platform to deliver some of the Casino stores. It is very clear that the activity is not full during all the day and some periods are still free for new logistics activities. We propose scenarios which can improve the productivity of the platform and consequently can decrease the over costs taking into account the free space of the platform during the day. To evaluate the potential benefits, we use the methodology described in the previous section.

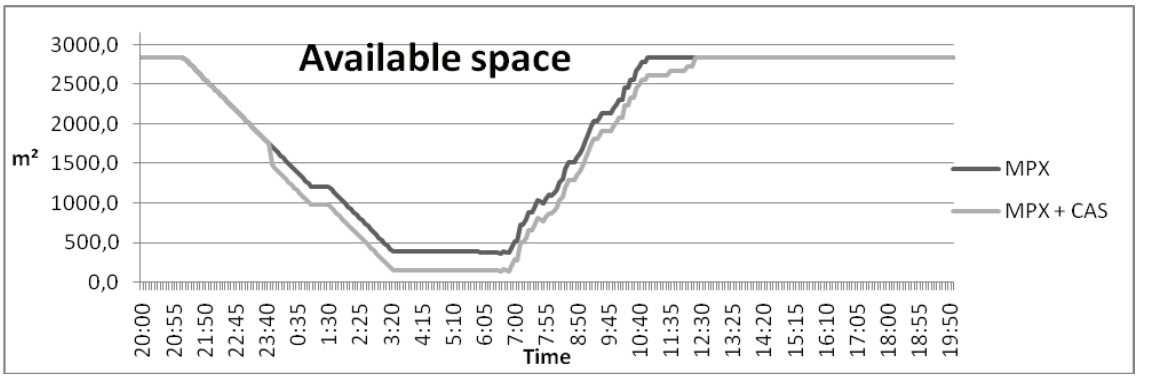

Fig. 2. Available space of the platform

4.2. Algorithm used and graphical examples

After having collected, reformulated and fixed the arrival times and departure times of the different lorries (the 26 NGV lorries and the two Diesel vehicles), the Excel macro examines the data by five minute intervals (the precision with which the times are noted by the operator):

- At t=0 (at 6am) the volume is the initial stock.
- If a lorry leaves Bercy, the volume of the number of corresponding pallets will be cut: rate of filling of the round in question, multiplied by the capacity of the carrier (15 or 21 pallets);
- If a NGV lorry has just positioned itself on a 1st MG-BSA round at Bercy, the volume of the number of loads of 12 empty pallets which it transports is incremented. The number of these loads is drawn from the PPO statement for the day concerned, and is proportional to the volume (all subsidiaries merged) of the shop which it has served in a fresh products rounds.

In this way we obtain an outline of the volume (Fig. 3), according to the time. The rounds of the Masséna Casino, identifiable in the transport plan, can be withdrawn in order to obtain a track of 100% of the activity of Monoprix. In the model – and in fact, in 95% of the cases – these are the last lorries to leave Bercy. So the model offers the option to obtain a route without taking into account Masséna.

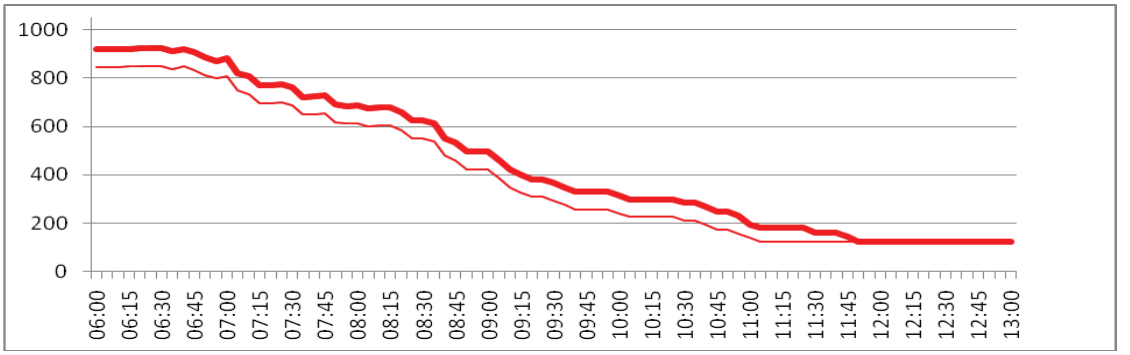

Fig. 3. Number of pallets

4.3. Assumptions

The completed information of the model only being available for March, three days of this month have been chosen to illustrate respectively the mean, the minimum and the peak of activity (Fig. 4).

- Maximum : 960 eq pal. ; the selected day 940 eq pal.
- Mean : 695 eq pal. ; the selected day 703 eq pal.
- Minimum : 472 eq pal. ; the selected day 550 eq pal.

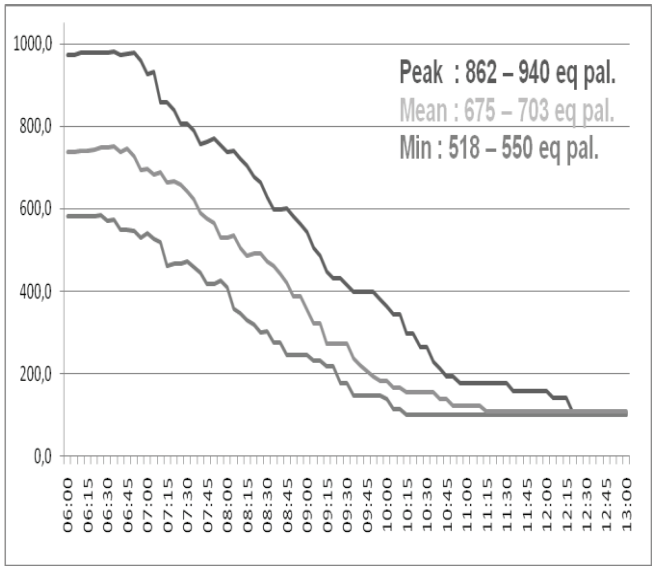

Fig. 4. Split of volume (maximum, mean and minimum)

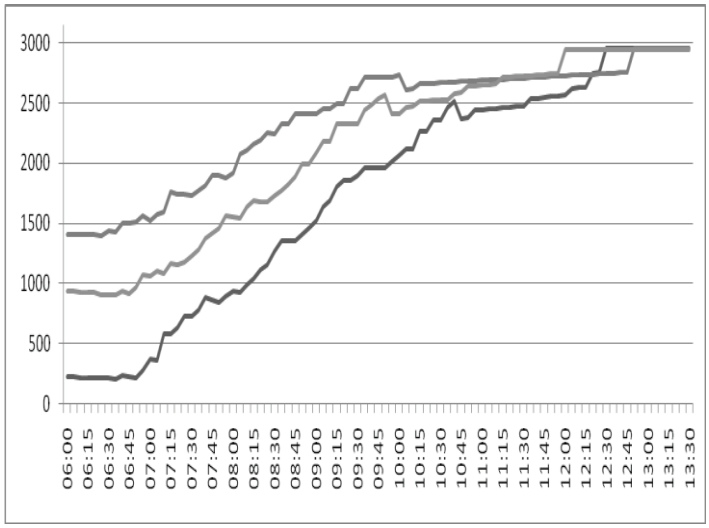

Fig. 5. Available space when flows are maximum, mean and minimum

These three levels result in the corresponding curves of available space (Fig. 5)

Reading this graph permits us to evaluate how many square meters could be sub-let to a third party:

- For a volume of the order of 700 pallets, 2000m² from 9am, and 900m² all day;
- For a volume close to the saturation of 940 pallets, 2000m² from 10am, Bercy being half empty from 9am.
- A Monoprix activity capable of stopping from 1pm; the departure time of the last Samada employees leaving Bercy being 2:40pm.

5. Step 1: Building the model, economic data

5.1. Points of cost

Between the current scenario and another, the points of cost which can vary have been identified as the following:

- Variable supplementary NGV costs (gas + mileage) on Bercy, linked, for example, to an increase in the number of rounds at Bercy;
- Variable NGV costs (gas and mileage) to withdraw from Bercy, if, for example, the flow from the departure of Bercy is directed to Combs and Lieusaint, thus decreasing the number of rounds ;
- The costs of overhang, that is to say the direct rounds of Combs and Lieusaint caused by an overrun of the capacity of Bercy;
- The overtime hours of the Bercy employees, potentially engendered by an increase of the cargo ;
- The drivers' overtime pay to pay to the carriers in case of an overrun of the monthly contract.

The factors of the fixed logistical costs have been considered as non-variables. Among them we find:

- The property costs ;
- The number of drivers and of the NGV lorries rented ;
- The costs of employees ; we suppose that the rise in premiums, charges... will unchange whatever the volume may be ;
- The annexed costs, such as maintaining the forklifts, printing paper, etc.

5.2. Variable NGV costs

The data relative to the cost of the NGV lorries is a monitoring issue effected monthly at Bercy, and details the points of the cost. The variable costs interesting to us here are proportional to the mileage: gas and maintenance. The mileage of the NGV lorries (equally used in the environmental notice) will be the object of the following paragraph.

The maintenance costs are billed by kilometre, at the rate of 0,41 euros/km for the 26T and 0,37 euros for the 16T. Within the study, it is an average of the two values for the 26T which have been used, then only the carriers of 21 pallets are implicated in the new scenarios, given by Ademe, the French Environment and Energy Management Agency.

As for gas, the price kept had those of april 2010, which takes into account the paying off of the NGV stations: 1.03 euros/ m3. This value is adjustable, in particular to no longer take into accounts the paying off (0.77 euros). To come back to the mileage, we must multiply by the average consumption of the vehicles, drawn from the statements of monthly gas consumption. The consumption observed is of 0.556 m3 / km for the carriers of 26T.

5.3. Costs of transport in a diesel vehicle from Combs and Lieusaint

The warehouses of Lieusaint and Combs-la-ville, which directly deliver to the shops which are not in the scope of Bercy, have also called to the smaller carriers in recent years : Hervé, TCM, O'clair, Yellow. These have a modest fleet at their disposal, at the order of 20 vehicles of which Samada is the biggest client. In compensation for a relative guarantee on the number of rounds bought, which permit these carriers to assure the paying off of their vehicles, Lieusaint and Combs-la-Ville benefit from more advantageous prices than those charged by the large transporters such as Géodis BM, GT or STAF, which are used by fresh products sites.

Like the other carriers, these propose prices according to the quantity of rounds commands with the utilisation of their vehicles: thus, at Hervé for example, the price of the 1st round in carriers of 26T is 180 euros, whereas the 3rd round is billed at 112 euros. In order to estimate the saving caused by the platform, we have kept the prices of the current round as given in Table 1.

The specificity of this transport policy is not without impact on the installation of the new scenarios. In fact, an increase of the volume passed via Bercy would cause a decrease of the volume delivered from Combs-Lieusaint and vice versa.

Table 1. Prices of tour considered in the model

	Tour 1	Tour 2	Tour 3
Lorries (26 T)	180 €	144 €	112 €
Articulated trucks	190 €	160 €	160 €

A decrease of the number of rounds from Combs-Lieusaint would no longer guarantee to the transporters the use of their lorries; therefore it is necessary to wait for an increase of the price of the round. This option has been taken into account for the saturation scenario of the Tuesday at 22 wagons, which simultaneously take back the volume of Combs-Lieusaint and generate overheads. The tariffs kept for the price of the turn of these overheads have been those practiced by the big transporters, who offer a more flexible allowance.

To sum up, the impact of the decrease of the rounds from Combs-Lieusaint and the loss of the use of the vehicles for the transporters which is linked to it, have been taken into account in degrading the purchasing conditions of the rounds.

5.4. Overtime

At the level of overtime for the employees of Samada/Bercy, the hypothesis has been made, with the management of the site, that a bigger cargo at 900 equivalent pallet processed by Bercy caused 1,5 more hours of overtime. It is based on an average because the necessity of supplementary hours depends largely on the cadences of the lorry returns; the days at 930 eq. pallets haven't reclaimed a single supplementary hour, whereas the days at 820 required overtime.

The price of overtime has been calculated in considering the cost of employees at the base of the Bercy budget firstly at one employee, then at one hour and in increasing this by 25%. the cost of the supplementary hour, of which the scale has been confirmed by the management, is at 31,33 Euros.

Respect to supplementary hours of the drivers, the current policy is to only remunerate the carriers for an overrun of the whole of the monthly contracts by all of the drivers concerned. To this regard, the second rounds, led to reposition themselves late at Bercy are compensated by the drivers not having had

to effectuate the second round, or having finished the day under their contract. In a case of an overrun corresponding to 2 rounds for the NGV lorries, that is to say for [volume in eq. pallets > 26 (vehicles)].[average capacity of a lorry].[rate of refill]. 2 (rounds), the contract is overrun by all and the 3rd Bercy rounds are billed as overtime.

A calculation estimating the necessary duration for the fresh products tours at Bercy permitted to find the same result. The cost of the drivers' supplementary hour, enquired about by the transporters, is at 35 Euros. In order to bring back the number of supplementary rounds in hourly volume, an average has been realised for the three days of usage between the departure time of the 1st Bercy round and the arrival time for the 2nd round. The value calculated and kept by the model is at 2.25h/round, confirmed by the operators.

5.5. Elements of calculations of the additional cost by pallet

The additional cost per pallet is an easy indicator to comprehend the economical pertinence of a new scenario, in relation to the approach of Thiais. The objective of Samada is to decrease by as much as possible the current 18%: in terms of communication, the announcement of a weak expense would constitute a validation of the approach of Monoprix and would incite other large names of large scale distribution to launch new experimentations.

The method to calculate the additional cost collects the following elements:

- transport: monthly track of the costs of the NGV, railway costs billed by Fret SNCF
- labor from the income statement of Bercy
- grant from Ademe (split on 7 years) t
- the real estate: estimation at 120 euros/m², should the cost be supported by Samada
- the other costs from the income statement of Bercy

The outline realised ex ante has only been modified to include each new shop enclosed in Bercy for the different scenarios, according to whether it would have been delivered via Thiais or directly. In the continuation of the hypotheses of [IT-Delaitre, 2009], there we had supposed that Thiais would have served the Monoprix in the same way as the shops which it had been serving at the time. As [IT-Delaître, 2009], the study takes into account the same group of shops, but it varies from one scenario to another and also makes this indicator not interesting.

At the level of the current outline, the study updated the volumes of the pallets (always considered for the period may 09 – april 10), and the posts of expenditure taken from the budget realised in 2010: costs of labor, real estate and the railway approach, distribution costs, annexed costs. The gain implicated by the application of a scenario is transferred to the distribution costs, with the exception of the reduction of the railway costs and the modification of the wage bill, respectively input with the costs of approach and the costs of human resources.

The additional cost per pallet currently assessed at Bercy is thus no more than 18%. The decrease of 8% in relation to the 26% calculated by IT-Delaître (2009) is above all to input at the top of the number of pallets distributed by NGV, of the order of 1000 pallets / month between the two studies. This tendency was already visible in [IT-Delaitre, 2009] (flagrant differences between the volumes of the end and begin of the year in 2009). After a period of coupling of NGV and Diesel distribution, Bercy has thus well trained itself to the specificities of NGV and better optimised its rounds. This manifests itself by the quasi-continuing decrease of the cost of the round (-20 Euros on average in one year).

In view of the budgetary balance sheets of Bercy the annexed costs have lightly decreased and the sub-letting of the reserve of the monop' stores have been deducted from the real estate costs, contributing to the decrease of the fixed costs. The volumes of Casino Masséna contribute finally at the base of the cost

by the pallet, at the order of 2%. The additional cost outside Casino activity thus that (which interests us), only takes into account the Monoprix volumes.

6. Step 1: Building the model, environmental data

The environmental report permitting to evaluate the impact of the new scenarios has reused the methodology and the formula of IT-Delaitre (2009). The incertitude linked to the data combined to the inevitable uncertainty of the choice of a modelling is without doubt a source of errors, but necessary to obtain an even macro result.

6.1. Mileage

In the environmental model, the emissions are proportional to the mileage realised by the vehicles. The variable NGV costs for Bercy have been equally calculated from the corresponding mileage. At the time of establishing the kilometres covered by scenario, one can classify the costs into two categories:

- Supplementary/Extra mileage in relation to the current situation: supplementary NGV traffic (Monoprix activity and eventual exterior services including the renting of NGV rounds), overheads generated, (in 21 pallet carriers or in trailers), and eventual delivery direct from Combs-Lieusaint to the Nation, Poissy, St Germain shops.
- Mileage saved: NGV traffic to deduct, direct departures from Combs-Lieusaint saved by the approach via Bercy.

A distance matrix realised on Google Earth for all of the shops which could potentially be added to Bercy produced, for each of them, not the shortest distance between Bercy-shop and Lieusaint-shop but the fastest path for a vehicle.

Nevertheless, the shops' loads being often linked in terms of one same lorry, the mileage for each shop did not equal two times the distance shop – Samada site. The choice to join such or such shop depending on the correspondence of the volumes for each day of the year, it is impossible to precisely determine the distances which a lorry covers to serve a shop, even if all of the shops to be served were given.

It was thus chosen to use the following formula to calculate a shop's contribution in kilometres:

$$mileage = \frac{(2+p) \times distance(store, platform) \times store\ volume}{21 \times fill\ rate\ of\ truck}$$

Where p is a percentage linked to the proximity of the joined shops, fixed arbitrarily at 15%. If a shop is delivered in one full round, the formula permits to find twice the distance between the site and ship; if this necessitates several supplementary rounds, we will find the distance corresponding to the volume. This formula does not represent a mileage truly realised, but an average which permits to estimate the globally distances, and which makes measure a weight kilometric more important for the larger shops. It gives some random results, reflecting the variability of the distances in function with the adjustment of the volumes.

6.2. Emissions of pollutants and GES

For the four types of pollutants analysed (CO2, NOx, PM, HCNM), the calculation of the Diesel emissions has been effected with the same data: according to the type of Diesel vehicle envisaged, use of relative data at the fleet of Combs-la-Ville, the vehicles being set off again between the different standard

euro dealing with their emissions and their consumptions. The values of these standards being documented, we can deduce, on average and for each type of vehicle, the emissions of CO2, NOx, PM and HCNM.

The calculation of the emissions is more arduous for the NGV vehicles, because there is no existing reliable source concerning the discharge of these vehicles: we only have the Ademe data for a tonnage at our disposal for a PTAC (authorized tonnage) 19 T vehicle. The idea is to check this data with that of a Diesel vehicle of the same tonnage, then deduce from this a NGV/Diesel ratio for each pollutant (excepting CO2) which has been applied for the two types of NGV vehicles, 21 and 15 pallets. This approach has nevertheless been validated.

In addition Iveco, one of the two providers of the NGV vehicles, has provided us the data for each of the pollutants in grams emitted by kilometre, by basing itself on the actual consumption and then modelling the motor's function. This data also figured in the Mines-Interface study, but wasn't chosen in favour of the Ademe method detailed in the preceding paragraph, for exterior validation reasons.

It is important to note that contrasting to the widespread idea, the NGV lorries give out more CO2 than the Diesel vehicles: 1148 g/km according to the Iveco data for a carrier 26T NGV, and 26.65 x 35.4 = 943 g/km for a 26T Diesel carrier liable for the standard Euro 4. Consequently, the CO2 saved by the Bercy approach is not only by the replacement of the articulated trucks by railway transport but also by the decrease of the distance to be crossed for the final delivery in relation to the previous deliveries from Thiais or even Combs-Lieusaint. However NGV offers excellent performance in terms of the other pollutants, in particular the particles.

7. Step 2: Define scenarios

To reduce the additional cost per pallet of Bercy, two gears exist to act upon: the increase of the volume which pays off the fixed cost by the addition of new shops to Bercy, and/or the decrease of fixed costs. This is the two axes which the optimisation strategy moves towards.

The different scenarios in consideration were the following:

- Saturation of the fixed resources by sizing them up on the peak of Friday and by leaving 22 cars (direct optimisation of the current system)
- Sized saturation on the biggest Tuesday, to 22 cars (functioning in almost-permanent saturation, and direct approach of the overheads from Combs and Lieusaint)
- Preservation of the current load and passage to 16 wagons, which cause a saturation on the Tuesday and some overheads
- Scenario at 16 wagons with different types of exterior benefit
- Conservation of the current outline, with mutualisation of flows for the Monop'.

These models can be confronted more in depth by playing on the following gears:

- Preservation (or not) of the Nation, Poissy, St Germain shops
- Humans Resources;
- Projections on the evolution of the variable NGV costs, the costs of the round on Combs/Lieusaint.

7.1. Determination of the saturation threshold

The saturation threshold is obtained when the minimum available space, during the morning activity, is close to zero m2. By playing on the number of rounds and the rate of filling, a volume of 1006 equivalent pallets can be extrapolated from the day data. Saturation is therefore reached around 6:35am and not at

the start of the activity, with an available space on the ground of 15m2, therefore almost useless in operational terms.

It has been confirmed on the plot that this volume of 1000 equivalent pallets was servable by Bercy, and corresponded to the saturation threshold: on Thursday 27th may 2010, Bercy served 996 equivalent pallets, being a convoy of 21 wagons plus the Casino volume. If the pallets had all able to be contained in Bercy, the movements of forklifts had been rendered extremely difficult (rows cluttered, necessity of bypass manoeuvres to mount the pallets), that which had contributed to slowing down the loading of the first lorries. Moreover, this day had engendered 2 hours and 40 minutes overtime for the morning team.

The site had nevertheless largely surpassed its transport capacity: Bercy had to call for 53 NGV rounds (that is to say a 3rd round), to the Diesel lorry delivering Poissy and St Germain, to three rounds for the Diesel 15 pallets delivering Nation, plus a truck 15 pallets of repair lent by Combs-la Ville, and two Hervé trucks (21 pallets) lent by Lieusaint in order to effect the surplus NGV rounds. With an extremely unfavourable exterior context, the activity finished around 2pm. However, no shop refused its goods.

Therefore we will deduct, from the theoretical calculation and the practical observations, that la Halle is saturated at 1000 equivalents pallets, modulo the usage of the third NGV rounds or, the case arising, the call to outside vehicles. The suppression of the Masséna rounds and the deportation, forseen by the study, of the Nation volumes to Combs and Lieusaint should permit to relieve the congestion of the doors and the loaders during the peak, to facilitate the twinning of the rounds within the lorries will make the saturation at 1000 eq. pallets more bearable in the operational plan and will allow a better service for the shops.

8. Step 3: Scenarios evaluation

If the current operating scenario does not satisfy the Samada, it offers the advantage of adding automatically new stores in Paris and particularly new Monop' stores on the platform without the risk of saturation. Costs are handicapped by the weight of rail costs and by the 22 cars who are not cushioned by the size of convoy. It is from this observation that the idea of scenarios of saturation through the addition of new internal Monoprix stores.

8.1. Current scenario

In the present scenario, a constant perimeter of 94 stores is assigned to Bercy, which delivers every day of the week. Once the volumes of Massena are disappeared, Bercy should concentrate only on Monoprix volumes, which is the historical maximum of 900 pallets, that is to say 100 pallets less than the saturation threshold. The additional cost of Monoprix is 20% (not considering the Masséna flows, otherwise the overvost is 18%) (26% with investment ITE) and the percentage of emissions reduction is 49% between before and after the implementation of the platform.

8.2. Scenario based on Friday saturation threshold

In all scenarios, the saturation on Friday is the one that less disturbs the current system: no change in structure, generated knockout and conservation of the railway services.

To calibrate the Friday peak on the saturation threshold it was necessary to add 10 stores to the scope of Bercy. The primary impact would weigh on Combs and Lieusaint, but still acceptable. The volumes removed would be about 100 pallets, they would save up to 7 or 8 tours per day, compared to the size of the two warehouses and reported to the three carriers, one can assume that their prices are not affected.

Nevertheless, Combs and Lieusaint lose flexibility, especially on Tuesday, its lowest day, which we would remove again a part of the load.

Finally, and this is a drawback shared by all scenarios of saturation, this working hypothesis raises the question of management of new stores, and in particular Monop' Stores: they should be allocated to Bercy, other stores would be withdrawn to be returned from Combs-Lieusaint. This phenomenon, which would occur at regular intervals, would push to review transportation plans and the traditional deliveries of stores.

Gains quantification. The economic gains of this scenario based on the economics of generating tours from Lieusaint, far more expensive than the additional costs of Bercy.

The increase is accompanied by a small generation of drivers and staff overtime. The distribution scenario 100% NGV is much more interesting, because the diesel delivery at the same price from Combs and Bercy, gave way to the delivery of new stores that save tours rental on Combs-Lieusaint.

The gains are modest, corresponding to 5-7% of EBITDA of Bercy on 2010. The volume increase, more than the economic results, can bring down the over costs per pallet to 6% (13% with rail investment) maintaining the flows Nation, Poissy, St Germain and 4% (11%) otherwise. Here, it is advantageous to abandon Diesel volumes.

At the environmental level, the abolition of direct deliveries saves mileage: on average 45 676 km with 100% NGV and 72 411 km in retaining Nation. The scenario with the best environmental record is of course one that keeps Nation, with 62 tons of CO2, 140 kg of particulate matter, 690 kg of NOx and 32 kg of HCNM saved, and gives an environmental report to -54%. The transfer volumes of diesel Combs has offset the gains resulting from the approach NGV, for a balance to -50%, substantially similar to the current value.

8.3. Scenario based on Tuesday saturation threshold

The gains of the scenario are again linked to the economy of tours from warehouses. It is reasonable to think that the consequences of 30% decline in volumes to be shipped from Combs and Lieusaint, prices would be a price increase by 10%.

For this scenario, the abandonment of Diesel volumes is required for many reasons: better economic results, overthrows less frequent and easier to manage, and comparatively environmental gain negligible (14 tons of CO2 saved per year by keeping nation for example). The strength of this scenario lies in the increased volume that places Bercy in a state of almost permanent saturation: hence a decrease of incremental costs, to -11%. As for environmental impact, despite the generation of overhangs, this scenario maximizes the use of NGV and rail as well, i.e. a decrease of -56% of emissions (-59% removing Nation) and the economy of 174 tons of CO2: it is the best ecological balance envisioned by the study.

The organisation of this scenario is therefore 11% cheaper than the approach via Thiais and even before taking into account any reductions in rail, but this figure should be contrasted because the scenario is artificially built to minimize this additional cost by calculating the largest possible number of pallets. We have seen that the economic record is not so eloquent and the difficulties to put in place, even if it is possible to implement, should be a huge barrier to its application.

8.4. Scenario based on 16 cars for the train

If the number of cars is reduced to 16 (even it can be to 22), in taking the value of 45 pallets per car, we obtain a volume of 720 equivalents pallet. The model, applied to a day of 730 equivalents pallet, gives the following results:

- The maximum volume occupied is obtained at 7am, after the unloading of the first lorries. The corresponding available space is of 860m2. This space would thus be available 24h/24, which would be rent. By taking a margin of security and considering the lost space necessary to separate the Monoprix pallets from the recipient's space, the surface of the sub-letable space in the rest of the study is 800m2.
- Outside rail business and labor, the decrease in volume would be a logistic error, for which activity would decrease compared to the current situation. After taking into account the reduction human resources, the results obtained is that economic activity provided by Monoprix and does not take into account the reduced cost rail and / or external service.
- The additional cost associated is 24% (25% excluding diesel volumes). There is an increase over the current situation, due to lower volume. Scenario of 16 cars does not seem to be relevant.

8.5. Sub letting the platform

The search for an outside partner to occupy 800 sqm of Hall all day should be easier than find new logistic activities in the afternoon, because it corresponds better with the existing scheduling deliveries in Paris today. However, it remains a similar difficulty: a company handling small volumes (storage capacity of the space provided does not exceed 266 pallets), ready to make extra offloadings and to pay them at Parisian prices…

The study considered the presence of a partner who would occupy the 800 sqm own way, and that could be installed, for example, racks to increase its storage capacity. It was also assumed handling operations could be performed by employees of Samada. The benefit would be more attractive and would dampen the six employees in the morning, still needed to overcome peak of truck returns early in the morning.

In terms of pricing, it was chosen to think in marginal cost and do not split, for example, the mobilisation of labor or utilities (electricity, cleaning ...) on the cost of delivery. If the current pricing in effect for volumes Casino Massena is greater than the marginal cost of an extra pallet to take account of these factors, it charges more Casino. An exorbitant price for logistical Casino accepts because of links with Monoprix and because they have not the choice to deliver one store in particular due to regulation.

This scenario reveals that it offers an extra cost per pallet much less attractive than the saturation to 22 cars (reducing the volume required) and constitutes a setback to the environmental point of view because some stores, daily delivered from Bercy, would be delivered directly for 42% of the time, thus generating mileage. The worst case scenario in this respect is the distribution and delivery with 100% NGV, which degrades by 10% the environmental gain, but also economically, the most interesting.

8.6. Negotiate the railway approach price (sensibility analysis)

It is impossible to determine what price would be proposed to Samada when renegotiating the contract in 2011. But it is possible to estimate roughly the percentage of decrease will be applied to the current going rate, and by comparing the scenarios, assessing the percentage to which a given scenario is better than another.

For each scenario, the extra cost as the economic balance is a linear function of the percentage reduction of the cost rail whose intercept equal to 0% and that the slope can be extrapolated from data at 5 or 10%. We deduce the percentage of rail cost reduction required to have an economic balance for each scenario.

Based this time on the extra cost to the pallet, we obtain the following conclusions and illustrate that in Fig. 6:

- The relative surcharge disappears with 8% decrease of the cost of rail through the scenario of saturation;
- Not surprisingly, the scenarios to reduce the 22 cars offer the best extra cost, especially the most extreme saturation on Tuesdays;
- In order to obtain better results with the reduction to 16 cars, the difference in cost of rail with the 22 cars scenario should be 22%;
- The scenario with 16 cars is relevant only from 10% reduction in rail costs more than 22 cars scenarios.

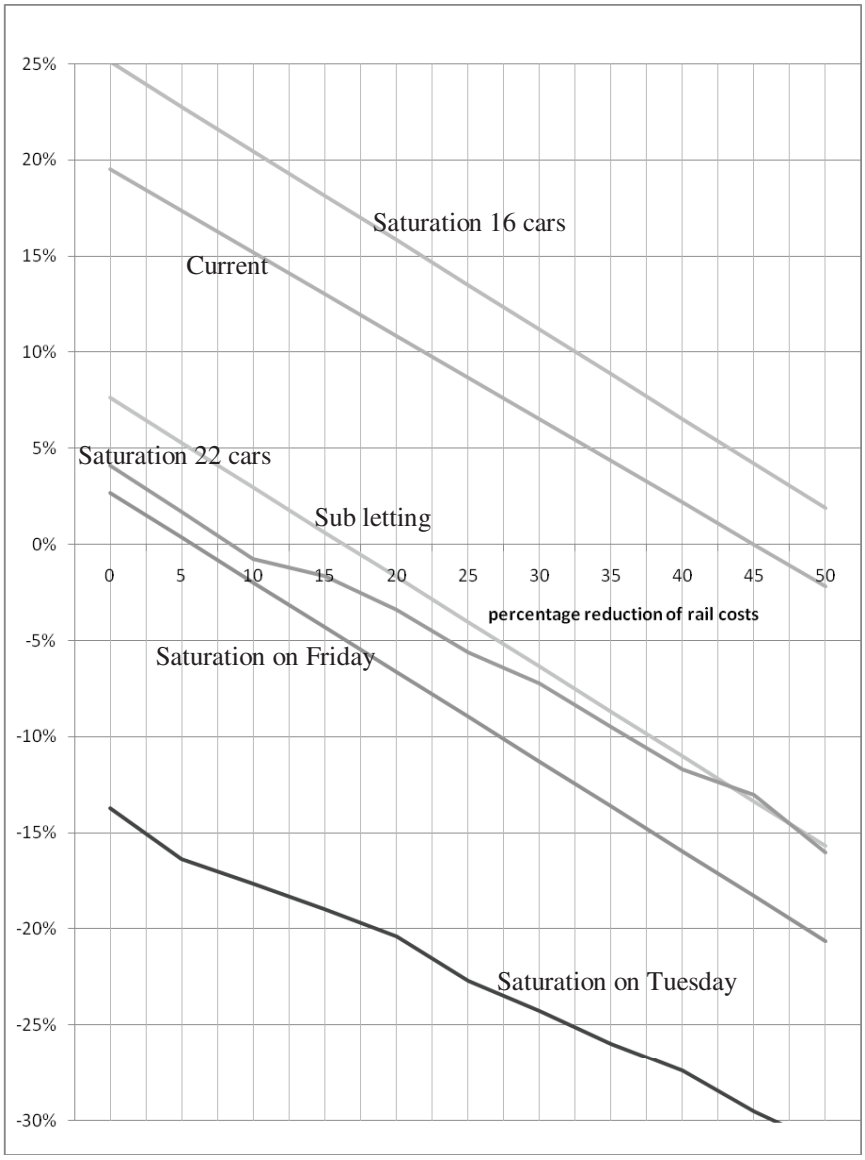

Fig. 6. Overcost per pallet function to the rail cost reduction percent

9. Conclusion

The aim of this paper was to consider the possibilities Samada had to make a viable alternative Bercy also economically and environmentally speaking. Considering the results obtained, this goal is not unachievable, given the over-pricing of railway equipment and under-utilisation of the platform and the NGV vehicles fleet. The scenario of saturation on Friday, relatively easy to implement, would reduce the overhead to zero if the pallet was accompanied by a decrease of only 10% of the cost of rail approach.

In this regard, it is regrettable that the specific economic data on the cost of this approach have not been obtained during the study. If some cost items, such as royalties or RFF labor VFLI were estimated, the cost of railway equipment or code-switching in share price, so crucial in assessing the interest scenario reduction to 16 cars, have never been identified.

Although the model is quite simple, available and pertinent data were difficult to use.

By reducing the size of the convoy to 16 cars, Samada would reduce its biggest cost, the train, but this scenario is only possible if Samada can manage all the pallets which would not be transported by train.

Finally, the indicator of the additional cost per pallet has a media image but should be handled with care to compare scenarios in which the boundaries can greatly differ (up to 250 pallets a day from a scenario to 16 cars and saturation on Tuesday!) and is based on a comparison with an ex ante (via Thiais), which requires assumptions increasingly retroactive and whose relevance is decreasing every year.

References

[1] Zunder TH, Ibanez JN. *Urban freight logistics in the European Unio*n. European Transport; 2004.
[2] Taniguchi E, Thompson RG. *Logistic system for sustainable cities*. ISBN: 0-08-044260-9, pages 450, Elsevier publication; 2004.
[3] Chwesiuk K. Urban Consolidation Centre as a part of city logistics. *Logistics*, vol. 4/2008. Poznań.
[4] Browne M, Sweet M, Woodburn A, Allen J. *Urban freight consolidation centres*. Final report for the Department for Transport. 2nd November 2005.
[6] Chwesiuk K, Kijewskaa K, Iwan S. Urban consolidation centres for medium-size touristic cities in the Westpomeranian Region of Poland. *ICL 2009*, Puerto Vallarta.
[7] Tamagawa D, Taniguchi E, Yamada T. Evaluating city logistics measures using multi agent model. *ICL 2009*, 30th june - 2nd july, Puerto Vallarta, Mexico.
[8] Ambrosino G, Boero M, Di Bugno M, Guerra S, Librato A. A centre for eco friendly city freight distribution : Urban logistics innovation in a mid-size historical city in Italy. *ICL 2007*, Greece.
[9] Interface Transport and Delaître L. *Evaluation de l'organisation de la distribution des marchandises dans Paris – Samada Monoprix*. Rapport D'étude, 2009.